

Stack Characterization System for Inspection of Contaminated Off-Gas Stacks

Challenge

As part of the Oak Ridge National Laboratory (ORNL) Central Campus Closure Project, the Department of Energy (DOE) Environmental Management (EM) Program must demolish the central gaseous waste system and associated facilities including the off-gas stacks and systems. These stacks range from 75 feet to 250 feet tall. Stacks are made of steel reinforced concrete with brick liners or unreinforced radial brick masonry with varying brick sizes and an acid-proof lining. Since being built in the 1950s, the central gaseous waste collection system has received no upgrades and minimal repair with some stacks now unsafe to access even for routine inspection. Some stacks, along with their associated filter banks, are highly contaminated with transuranic material and other radionuclides while being located adjacent to active operating facilities in a densely populated section of ORNL. Waste segregation obligations dictate that stacks must be characterized before demolition; however, it is hazardous to place humans in close proximity to stacks that may be structurally unsound, and full personal protection equipment restricts the quality and length of characterization operations. Characterization coverage can be sporadic and limited to available accessible areas and not necessarily areas most likely to be the most contaminated.

Tech Solution

The stack characterization system (SCS) is a tele-operated remote system that collects samples and data to characterize the quantitative and qualitative levels of contamination inside off-gas stacks protecting workers from the physical, radiological and chemical hazards of deteriorating contaminated stacks. Data collection targets the pre-demolition survey needs for structural, health physics and waste management analysis.

The system under development deploys into the top of stacks via an external overhead crane. The SCS consists of two stages of tripod sections connected in line by a rotating positional joint. The upper tripod is used for stabilization against the stack walls. The lower tripod section, controlled independently from the upper section, is used to position survey instruments against the inside stack walls. Survey instruments include alpha/beta/gamma radiological detectors, smear sampling, and core sampling. Position information—depth in the stack and rotation within the stack—is recorded and identified for each survey position. An array of real-time video cameras provide guidance for remote systems operators for entrance and egress in the stack and for targeting areas of interest inside the stack for inspection and survey. Video is recorded to provide data for further analysis.

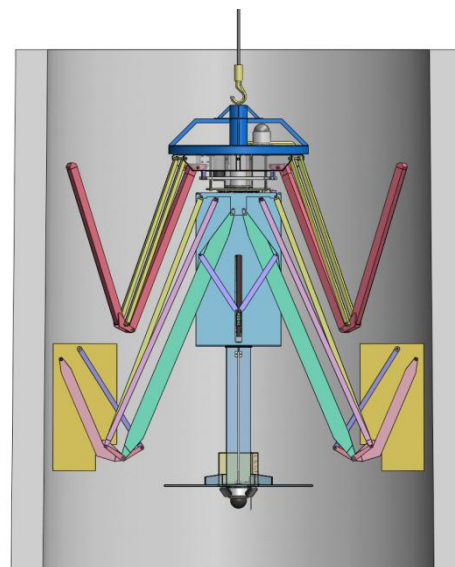


Figure 1: SCS inside off-gas stack

Site Project & Identifier

PBS OR-0042 – Nuclear Facility D&D Oak Ridge
National Laboratory

Tech Stage: Development

Stack Characterization System for characterizing
quantitative and qualitative levels of contamination.

Tech Accomplishments

The SCS is currently under development. To date, the functional requirements and conceptual design have been completed. Fiscal year 2010 funding has targeted completion of the following tasks: experimental testing and development for verification and refinement of the design concept, detailed design, fabrication, and commercial off-the-shelf components procurement. Fiscal year 2011 includes assembly, integration, and cold testing followed by a field demonstration of capability and commercialization.

Impact

Off-gas stacks may not only be contaminated but also structurally unsound. These stacks have the added physical hazards of extreme height and the requirement of working in full personal protective equipment that limits work time and task dexterity. The stacks cannot currently be fully characterized through standard methods since a workable method, for complete access, does not exist. The current baseline approach estimates are based on minimal survey data at limited access points.

The SCS provides a previously unavailable means to survey internal surfaces of stacks without exposing workers to hazardous environments or physical danger. The SCS provides improved worker safety and improved quality of data at the same time.

Impact and Features

- Provides previously unavailable survey capability for contaminated structurally unsound off-gas stacks (enabling technology)
- Protects workers from environmental and physical hazards
- Capabilities
 - Alpha/beta/gamma radiological survey
 - Smear sampling
 - Core sampling
 - Recorded video for analysis and documentation
- Features
 - Crane-deployed into the top of the stack
 - Designed for redeployment in multiple stacks

Vendor/Provider Information

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Challenge Category

- Characterization

Tech Solution Category

- Characterization
- Robotics and Remote Systems